REMARKS

By this amendment, claims 1, 11 and 14 have been amended. Currently, claims 1-14 are pending in the application.

Claims 1 and 10 were rejected under 35 USC 103(a) as being obvious over Crecelius et al. (U.S. Patent No. 6,396,161) in view of Rawcliffe (U.S. Patent No. 4,260,923). The Examiner stated that Crecelius et al. disclosed an induction machine 12, a sensor 52, an inverter 74 having a plurality of switches in Fig. 4 and the inverter is connected to the windings 38 and microprocessor is connected to the inverter 74 in Fig. 3. The Examiner also stated that the controller used pole width modulation signals 68. The Examiner admitted that Crecelius et al. do not disclose using pole phase modulation to change the number of poles.

The Examiner stated that Rawcliffe disclosed pole phase modulation for the purpose of minimizing unwanted harmonics in electrical machines may be used to change the number of poles in motor or generator citing column 2, lines 6-24. The Examiner believed that it would have been obvious to design a system using an induction machine disclosed by Cercelius et al. and modify it by using the pole phase modulation as disclosed by Rawcliffe.

This rejection is respectfully traversed in view of the amendments to claim 1 and the following remarks.

The present invention relates to a system comprising an induction machine with a stator and a rotor; an inverter and a programmable microprocessor. The microprocessor (or DSP) includes a means for operating the induction machine using pole phase modulation. The system also includes a position sensor connected to the induction machine for providing a position indication that is indicative of a relative position of the rotor and the stator. The stator for the induction machine has a plurality of phases.

As discussed in the application, pole phase modulation (PPM) is a specific type of control for an induction machine. It is one of the methods for changing the number of machine poles without using any contactors or mechanical switches.

The method of using PPM is a method of changing the number of pole pairs of an AC machine winding without the need for contactors or mechanical switches. By its concept, mathematically, PPM is a generalized form of the Pole-Amplitude Modulation (PAM) method:

- The number of phases with PAM is fixed, while with PPM it can vary.

- PAM allows for pole change only in the ratio p:(p-1) while PPM provides for an arbitrary ratio.

The PPM implementation consists of selecting the number of pole pairs by controlling the phase shift between currents in the elementary phases, where each elementary phase consists of a coil or a group of coils connected in series. Since all conductors of the winding are energized at each pole pair combination, a machine with PPM has much better utilization of active material than a regular machine with separate windings for each pole pair.

As also disclosed in the specification, Dahlander's connection only allows one, 2:1, ratio between the number of pole pairs created by a single winding. In contrast, the number of pole pairs in PPM is arbitrary. Basically, the PPM method uses the inverter switches to re-connect machine coils in the desired pole-phase configuration. The principles of PPM are illustrated in the application using an example of two different numbers of pole pairs generated by a single winding. Since the winding configuration in PPM varies as a function of the number of pole pairs at lower speeds, the principles of PPM were described relating to a 72 slots, 4/12 pole toroidal machine. This is only one of many examples of the PPM method. All of these aspects of pole phase modulation control include the ability to change the

number of stator and rotor poles to a plurality of pole combinations.

Claim 1 has been amended to recite that the system includes "a programmable microprocessor operatively connected to said inverter and including a program for controlling said inverter that includes means for operating said induction machine using pole phase modulation to change the number of stator and rotor poles to a plurality of pole combinations". This feature is not shown or suggested by any of the prior art references of record.

Crecelius et al. relates to a marine integrated starter alternator troller device (ISAT). Crecelius et al. includes an induction machine 12 that does not change the number of poles. Crecelius et al. operates with a constant machine that is closed and they do not change the number of poles. Thus, Crecelius et al. do not include a programmable microprocessor with a means for operating the induction machine 12 using pole phase modulation to change the number of stator and rotor poles to a plurality of pole combinations.

Rawcliffe does not make up for the deficiencies in Crecelius et al. Rawcliffe relates to a system that uses pole amplitude modulation (PAM). PAM is a fixed ratio method. Also, the PAM technique cannot get integral ratios of pole changes, like 2:1 or

3:1. Conventionally, PAM techniques were developed for large pumps or fans where they had to adjust the speed either up or down by a small fraction. When you had a load that was cubic, PAM made a big difference in power and full power was not needed all the time. As described above, PPM and PAM are two methods that are fundamentally different.

Applicants respectfully submit that one of ordinary skill in the art would not have combined Crecelius et al. with Rawcliffe to achieve the claimed invention. Specifically, Crecelius et al. and Rawcliffe do not teach or suggest a programmable microprocessor with a means for operating the induction machine using pole phase modulation to change the number of stator and rotor poles to a plurality of pole combinations.

Applicants also respectfully submit that there is no teaching in either reference for such a combination. It is therefore submitted that claims 1-10 are allowable over the prior art of record.

Claims 2-4 and 9 were rejected under 35 USC 103(a) as being obvious over Crecelius et al. and Rawcliffe and in view of Miyazaki et al. (U.S. Patent No. 5,994,881). The Examiner admitted that the combined system of Crecelius et al. and Rawcliffe did not disclose using vector control. The Examiner

believed that Miyazaki et al. disclosed using vector control for the purpose of minimizing the cost of generators and effectively determining the position of the poles as shown in Fig. 1A and 1B.

This rejection is respectfully traversed in view of the amendments to claim 1 and the following remarks.

Miyazaki et al. discloses a synchronous generator only. These synchronous generators are controlled differently than induction generators as is well known in the art. It is also well known that these two machines require two different types of control. Thus, one of ordinary skill in the art would not combine a vector control from a synchronous generator into the induction machines of Crecelius et al. and Rawcliffe. Also, there is no teaching or suggestion for such a combination of references. It is therefore respectfully requested that this rejection be withdrawn.

Applicants also note that the subject matter of claims 2-4 was not addressed in this rejection.

It is respectfully submitted that claims 2-4 and 9 are also patentable for the reasons given above.

Claim 8 was rejected under 35 USC 103(a) as being obvious over Crecelius et al. and Rawcliffe and in view of over Le (U.S. Patent No. 5,350,988). The Examiner stated that the combined

system of Crecelius et al. and Rawcliffe did not disclose using a digital signal processor. The Examiner stated that Le disclosed a digital signal processor 70 for the purpose of providing precise synchronized control in an electrical machine. The Examiner believed that it would have been obvious to use the DSP in the electrical machine of Le in the combined system of Crecelius et al. and Rawcliffe.

This rejection is respectfully traversed in view of the amendments to claim 1 and the following remarks.

Le discloses digital control of a Brushless DC Motor (BDCM) that is typically a permanent magnet synchronous machine having distinct, fixed number of permanent magnet poles on the rotor. Le describes control for the brushless motor, as stated in column 1, lines 10-13, lines 66-67 and claims 1 and 14. In Le, the phase number is restricted to 3, as is typical of the state of the art. Le cannot operate his machine using pole phase modulation.

Le, like Miyazaki, discloses a synchronous generator which is controlled differently than the induction machines claimed in the present invention. As described above, one of ordinary skill in the art would not combine a control from a synchronous generator into the induction machines of Crecelius et al. and Rawcliffe.

Also, there is no teaching or suggestion for such a combination of references. It is therefore respectfully requested that this rejection be withdrawn.

Claims 5-7 and 11-14 were rejected under 35 USC 103(a) as being obvious over Crecelius et al., Rawcliffe and Miyazaki et al. in view of Miller et al. (U.S. Patent No. 5,977,679). The Examiner stated that the combined system of Crecelius et al., Rawcliffe and Miyazaki et al., did not disclose using a toroidally wound stator. The Examiner stated that Miller et al. disclosed for the purpose of promoting heat dissipation, a toroidally wound stator in Fig. 1.

This rejection is respectfully traversed in view of the amendments to claims 1, 11 and 14 and the following remarks. Claims 11 and 14 have been amended in a similar fashion as claim 1.

Crecelius et al., Rawcliffe and Miyazaki et al. do not use an induction machine with a toroidal rotor. This combination of references is also improper as discussed above as one of ordinary skill in the art would not combine these references together to meet the claimed invention.

Miller does not make up for the deficiencies in these cited references. Miller does not teach or suggest how or why one of

ordinary skill in the art would combine these references in the manner suggested by the Examiner.

Crecelius et al., Rawcliffe, Miyazaki et al. and Miller, individually or in combination, do not teach or suggest a system including a programmable microprocessor with a means for operating the induction machine using pole phase modulation to change the number of stator and rotor poles to a plurality of pole combinations. It is therefore respectfully submitted that this rejection has been overcome and should be withdrawn.

Applicants respectfully submit that the application is now in condition for allowance and an action to this effect is respectfully requested.

If there are any questions or concerns regarding this application, the Examiner is requested to telephone the undersigned at the telephone number listed below.

Respectfully submitted,

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